How to Buy Energy-Efficient Residential Windows

Energy Efficiency and Renewable Energy
Federal Energy Management Program

Why Agencies Should Buy Efficient Products

- *Section 161 of the Energy Policy Act of 1992 (EPACT) encourages energy-efficient federal procurement. Executive Order 12902 and FAR section 23.704 direct agencies to purchase products in the upper 25% of energy efficiency.*
- *Agencies that use these guidelines to buy efficient products can realize substantial operating cost savings and help prevent pollution.*
- *As the world's largest consumer, the federal government can help "pull" the entire U.S. market towards greater energy efficiency, while saving taxpayer dollars.*

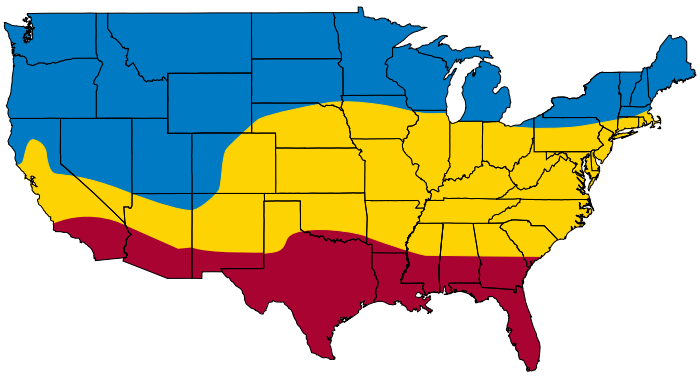
Efficiency Recommendation[a]

Climate Zone[b]	Recommended		Best Available	
	SHGC	U-factor	SHGC	U-factor
Heating	(c)	0.35 or less	(c)	0.15
Heating & Cooling	0.55 or less	0.40 or less	0.20[c]	0.15
Cooling	0.40 or less	0.75 or less	0.20	0.15

a) To receive these thermal performance ratings (SHGC and U-factor), windows must be certified by the National Fenestration Rating Council (NFRC).

b) The map below broadly identifies the relevant climate zones for the U.S.

c) Low SHGCs save cooling energy but increase heating energy. Therefore, lower SHGCs are most important where cooling costs dominate.



Definitions

SHGC, or Solar Heat Gain Coefficient, is a measure of the solar radiation admitted through a window. SHGC ranges between 0 and 1; the lower the number, the lower the transmission of solar heat. SHGC has replaced shading coefficient (SC) as the standard indicator of a window's shading ability. SHGC is approximately equal to the SC multiplied by 0.87.

U-factor is a measure of the rate of heat flow through a window. The U-factor is the inverse of R-value, or resistance, the common measure of insulation.

For More Information:

- DOE's Federal Energy Management Program (FEMP) Help Desk and World Wide Web site have up-to-date information on energy-efficient federal procurement, including the latest versions of these recommendations.
  Phone: (800) 363-3732
  http://www.eren.doe.gov/femp/procurement
- DOE lists vendors of ENERGY STAR® windows and offers other information to help select energy-efficient residential windows.
  Phone: (800) 363-3732
  http://www.energystar.gov
- Efficient Windows Collaborative provides information on energy-efficient windows, including a simulation software, RESFEN.
  Phone: (202) 530-2245
  http://www.efficientwindows.org
- National Fenestration Rating Council (NFRC) lists energy performance of windows in the *NFRC Certified Products Directory.*
  Phone: (301) 589-6372
  http://www.nfrc.org
- Residential window technology and selection criteria are covered extensively in *Windows: A Guide to New Technologies and Energy Performance*, published by W.W. Norton & Company.
  Phone: (800) 287-8655
- American Council for an Energy-Efficient Economy (ACEEE) publishes the *Consumer Guide to Home Energy Savings*.
  Phone: (202) 429-0063
  http://aceee.org
- Lawrence Berkeley National Laboratory provided supporting analysis for this recommendation.
  Phone: (202) 484-0880
  http://windows.lbl.gov

Where to Find Energy-Efficient Windows

The General Services Administration (GSA) will soon offer residential windows through its Federal Supply Schedule 56-IV(A), "Construction and Building Materials."

When contracting for residential windows, specify NFRC-rated SHGC and U-factor values that meet this Efficiency Recommendation for your geographic region. When buying commercially, look for windows with the EPA/DOE ENERGY STAR® label, all of which meet this Recommendation.

Buyer Tips

Several characteristics of windows affect their efficiency. Features that reduce winter heat loss (lower U-factors) include: insulated glazing units ("IG units"), with two or more panes; "low-e" (low-emittance) coatings, which minimize thermal radiation; low-conductance gas fills (usually argon or krypton); and low thermal conductance spacers and window frames. Weatherstripping in operable windows reduces air leakage (AL), which will soon be rated on NFRC labels (look for AL ratings of 0.30 or below). Energy-efficient windows also minimize occupant discomfort and decrease condensation.

An effective strategy to reduce summer heat gain is the use of windows with low-e coatings, especially *spectrally selective* low-e coatings, which reduce SHGCs and U-factors, but not visible light or color. Tinted windows may also reduce solar heat gain, although they transmit less visible light. Visible transmittance (VT) will also be rated on NFRC labels in the future.

Usage Tips

To prevent air infiltration when outside temperatures are extreme, keep windows tightly closed and locked; this saves energy as well as preventing drafts. Interior shades and blinds can also help reduce unwanted solar heat gain.

Windows Cost-Effectiveness Example (1,540 sq. ft. house in Washington, D.C.)

Performance	Base Model	Recommended Level	Best Available
Window Description	Double-paned, clear glass, aluminum frame	Double-paned, low-e coating, wood or vinyl frame	Triple-paned, tinted, two spectrally selective low-e coatings, krypton-filled, wood or vinyl frame
SHGC	0.61	0.55	0.20
U-factor	0.87	0.40	0.15
Annual Heating Energy Use	547 therms	429 therms	426 therms
Annual Cooling Energy Use	1,134 kWh	1,103 kWh	588 kWh
Annual Energy Cost	$290	$240	$210
Lifetime Energy Cost	$4,100	$3,400	$3,000
Lifetime Energy Cost Savings	–	***$700***	***$1,100***

Definition

Lifetime Energy Cost Savings is the sum of the discounted value of annual energy cost savings, based on average usage and an assumed window life of 25 years. The assumed gas and electricity prices are 40¢/therm and 6¢/kWh, the 1996 federal average energy prices in the U.S. Future energy price trends and a discount rate of 4.1% are based on federal guidelines (effective from April, 1998 to. March, 1999).

Cost-Effectiveness Assumptions

The model shown above is the result of a simulation using a residential windows modeling program called RESFEN. Calculations are based on a prototype house: 1,540 sq. ft., two stories, a standard efficiency gas furnace and central air conditioner, and window area covering 15% of the exterior wall surface area (equally distributed around the house).

Using the Cost-Effectiveness Table

In the example above, new or replacement windows at the Recommended Level are cost-effective if their purchase price does not exceed the price of the Base Model windows by more than $700. Similarly, the Best Available windows are cost-effective if their price is no more than $1,100 above the price of Base Model windows.

Metric Conversions

1,000 sq. ft. = 93 sq. meters
1 therm = 100,000 Btu
= 29.3 kWh
= 105.5 MJ

How do I assess the energy savings potential for my situation?

RESFEN, which is available on the Efficient Windows Collaborative Web site (see "For More Information"), can estimate the heating and cooling costs for many house types, given an approximate knowledge of a few key parameters such as square footage, window area, heating and cooling types, and utility rates. Although the estimated energy costs may not always closely predict actual values, the differences between various window types are generally very accurate.

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